NAVSHIPS 95742

INSTRUCTIONS

MODELS 101 & 101-50

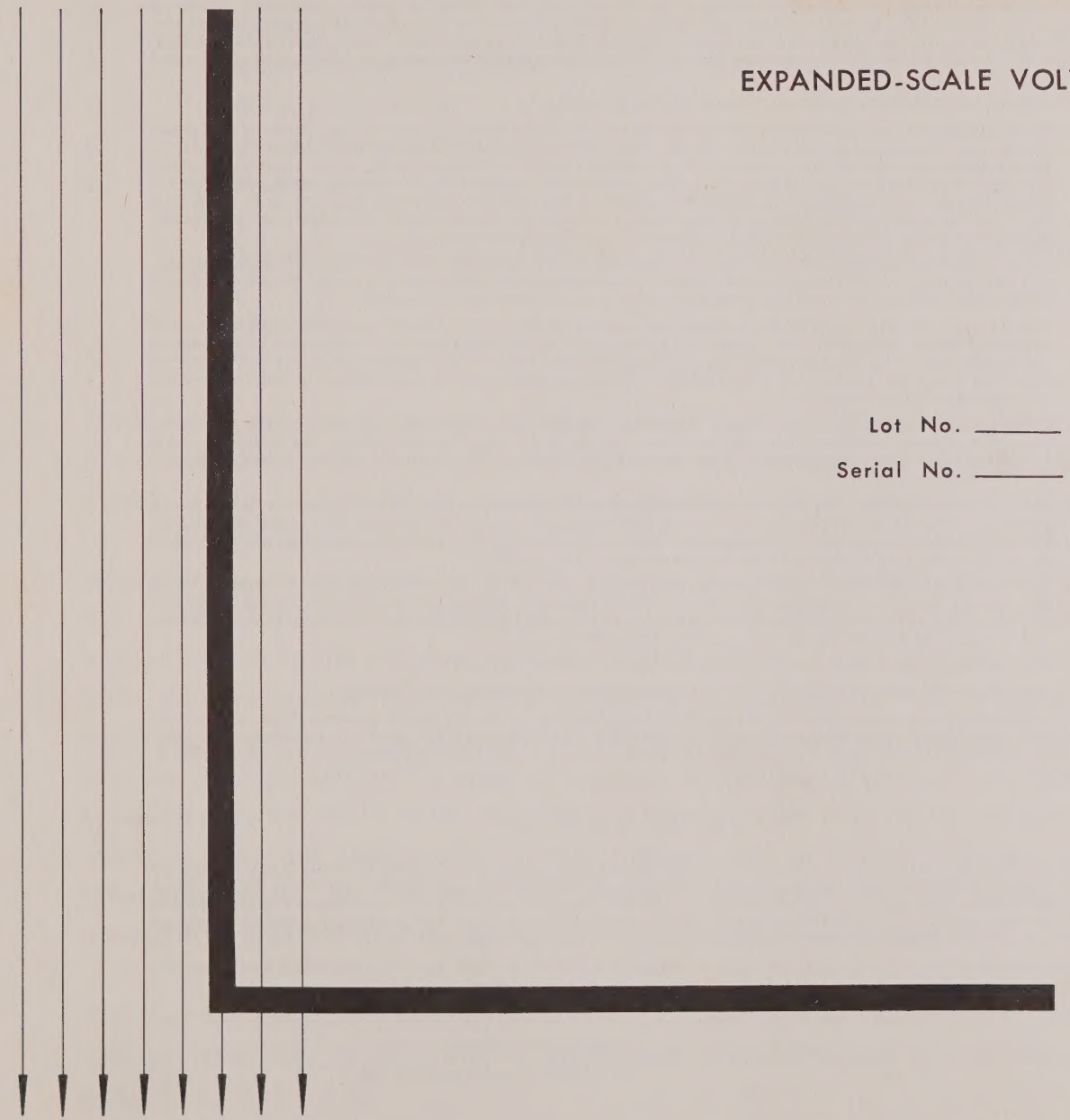
Beckman® INSTRUMENTS, INC.
BERKELEY DIVISION

NAVSHIPS 95742

INSTRUCTION MANUAL

MODELS 101 & 101-50

EXPANDED-SCALE VOLTMETER



Lot No. _____

Serial No. _____

Beckman® INSTRUMENTS, INC.

BERKELEY DIVISION
2200 Wright Avenue
Richmond, California

20 June 1957

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

(e) The Company expressly disclaims any liability to its customers, dealers, and to users of its products, and to any other person or persons for consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, repair, replacement of, or arising out of or in any way connected with the use of any of its products.

(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
BECKMAN INSTRUMENTS, INC.

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GENERAL DESCRIPTION

Models 101 and 101-50 are expanded scale voltmeters designed to measure a-c voltages over the range of 50 to 2000 cps with an accuracy of 0.5%. The Model 101 has an indicating meter scale 12 volts wide and covers the range of 100 to 500 volts in 40 overlapping 12-volt ranges. The operator positions two front panel rotary switches to establish a desired 12-volt range, such as 290 to 302 volts or 300 to 312 volts. The Model 101-50 has a 6-volt indicating scale and covers the range of 50 to 250 volts in 40 overlapping 6-volt ranges. With this instrument the operator positions similar switches to select a 6-volt range such as 115 to 121 volts or 120 to 126 volts. Model 101 and 101-50 are identical except for the ratio of primary to secondary turns on the input transformer, the scale of the indicating meter, and the labeling on the range switches. All the information in this manual applies to both models unless otherwise noted. Models 101R and 101R50 are Models 101 and 101-50 respectively constructed to be mounted in a standard 19-inch relay rack.

The specified accuracy of the voltmeter is not affected by variations in line voltage from 100 to 130 volts or by changes in tube characteristics due to aging or replacement.

A zero to one milliampere recorder may be attached directly to the instrument. The voltmeter has been designed to present a critical damping resistance to an Esterline-Angus recorder but other recorders may be used.

SPECIFICATIONS

Metering Range

Model 101: 100 to 500 volts in 40 overlapping 12-volt ranges

Model 101-50: 50 to 250 volts in 40 overlapping 6-volt ranges

Frequency Range of Signal Being Metered

50 to 2000 cps

Power Supplied by Signal Being Metered

2 watts maximum

Approximate Current Drain on Signal Being Metered

Model 101:	20 ma at 100 volts, 50 cps
	5 ma at 100 volts, 1000 cps
	4 ma at 500 volts, 50 cps
	1 ma at 500 volts, 1000 cps
Model 101-50:	40 ma at 50 volts, 50 cps
	10 ma at 50 volts, 1000 cps
	8 ma at 250 volts, 50 cps
	2 ma at 250 volts, 1000 cps

Type of Indication

In volts rms

Accuracy

±0.5% of voltage being metered. Negligible additional error with moderate distortions of sine-wave input. (See Tables 1 and 2.)

Recorder Requirements

Full scale range: 1 ma

Input resistance: 1400 ohms ±20%

Critical damping resistance: 30,000 ohms ±50%

Power Requirements

100 to 130 volts, 50 to 2000 cps, 25 watts

OPERATING THE VOLTMETER

With no connection to the INPUT terminals, plug the power cord into a 117-volt, 50 to 2000 cps source of line power. Turn the left-hand rotary switch to any position other than OFF. The green POWER pilot light should glow indicating that the circuitry is energized. Allow the instrument to warm up several minutes before attempting a measurement.

If no recorder is attached to the voltmeter place the RECORDER toggle switch at OFF; with a recorder attached the switch may be at either ON or OFF. The two front-panel rotary switches select the 6 or 12-volt metering range. The number indicated by the left-hand switch plus the number indicated by the right-hand switch is the lower end of the range. For example, if the switches indicate 200 and 30, the range begins at 230 volts. To avoid damaging the voltmeter the operator should take care not to apply a voltage across the INPUT terminals far higher than the range selected. Following the metering procedures described in paragraphs below will insure that no damage occurs. The instrument will withstand voltages twice that indicated by the range switches for long periods and three times that indicated for a few minutes, but still higher voltages may damage it quickly. See "Specifications" for the power and current drain on the signal being metered. Neither INPUT terminal is grounded.

Metering Procedure for Model 101. Place the left-hand range switch at "400" and the right-hand switch at "0". This selects a 12-volt range beginning at 400 volts. Then, apply the signal to be measured (an a-c voltage between 100 and 500 volts rms) across the INPUT terminals and note the meter reading. If the meter reads on-scale or off-scale at the high end, the applied voltage is above 400 volts. Therefore, if necessary rotate the right-hand switch clockwise, raising the range 10 volts per step, until the meter reads on-scale. If the meter reads off-scale at the low end with the range switches at "400" and "0", the applied voltage is below 400 volts.

Therefore, lower the range in 100-volt steps; by rotating the left-hand switch clockwise until the meter reads on-scale or off-scale at the high end, indicating that the voltage is between the switch indication and 100 volts above the switch indication. Then, if necessary, rotate the right-hand switch clockwise, raising the range in 10-volt steps, until the meter reads on-scale. When the meter is on-scale, the applied voltage equals the sum of the range switch indications plus the panel meter reading. For example, with the left switch at 300, the right switch at 70 and the meter indicating 9.4, the applied voltage is 379.4 volts rms ±0.5%.

Metering Procedure for Model 101-50. Place the left-hand range switch at "200" and the right-hand switch at "0". This selects at 6-volt range beginning at 200 volts. Then, apply the signal to be measured (an a-c voltage between 50 and 250 volts rms) across the INPUT terminals. If the meter reads on-scale or off-scale at the high end, the applied voltage is above 200 volts. Therefore, if necessary, rotate the right-hand switch clockwise, raising the range 5 volts per step, until the meter reads on-scale. If the meter reads off-scale at the low end with the range switches at "200" and "0", the applied voltage is below 200 volts. Therefore, lower the range in 50-volt steps by rotating the left-hand switch until the meter reads on-scale or off-scale at the high end, indicating that the voltage is between the switch indication and 50 volts above the switch indication. Then, if necessary, rotate the right-hand switch clockwise, raising the range in 5-volt steps, until the meter reads on-scale. When the panel meter is on scale the applied voltage equals the sum of the range switch indications plus the panel meter reading. For example, with the left switch at 150, the right switch at 35 and the meter indicating 2.6, the applied voltage is 187.6 volts rms ±0.5%.

Accuracy. With a sine-wave input the voltmeter reading is accurate to within 0.5%. When the input waveform is distorted by the presence of harmonics an additional error is introduced as shown in Tables 1 and 2. Notice that the additional error is quite slight for moderate harmonic content. Note also that the error varies in proportion to the panel meter

reading. The error is zero when the panel meter reads zero regardless of harmonic content. This is because the voltmeter operates by, in effect, subtracting the range switch indication from the applied voltage and measuring the difference on the panel meter. The initial subtraction occurs in a thermal bridge, which reacts to true rms values; consequently, no error is introduced there. The panel meter, however, is deflected in proportion to average value although it is calibrated in rms values.

		PANEL METER INDICATION		
		0	4	8
POSSIBLE ERROR IN VOLTS	with 10% 2nd Harmonic	Zero	Zero	Zero
	with 10% 3rd Harmonic	Zero	0.15	0.30
	with 10% 4th Harmonic	Zero	Zero	Zero
	with 10% 5th Harmonic	Zero	0.10	0.20
	with 10% 7th Harmonic	Zero	0.06	0.12

TABLE 1. ERROR DUE TO HARMONIC CONTENT, MODEL 101

		PANEL METER INDICATION		
		0	2	4
POSSIBLE ERROR IN VOLTS	with 10% 2nd Harmonic	Zero	Zero	Zero
	with 10% 3rd Harmonic	Zero	0.075	0.15
	with 10% 4th Harmonic	Zero	Zero	Zero
	with 10% 5th Harmonic	Zero	0.05	0.10
	with 10% 7th Harmonic	Zero	0.03	0.06

TABLE 2. ERROR DUE TO HARMONIC CONTENT, MODEL 101-50

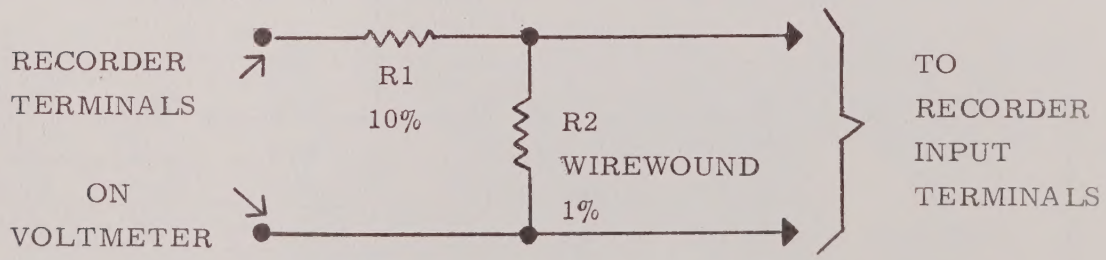
USING A RECORDER

Current Recorder. This instrument is designed to operate with an Esterline-Angus recorder having a full-scale range of 0 to 1 ma, an input resistance of

1400 ohms and a critical damping resistance of about 30, 000 ohms. Other recorders may be used provided they meet these requirements. To attach a recorder, connect its input terminals to the RECORDER terminals on the voltmeter and place the RECORDER toggle switch at ON. This connects the recorder in series with the front-panel millimeter. Zero current at the RECORDER terminals corresponds to the voltage indicated by the range switches. One milliampere current corresponds to the voltage indicated by the range switches plus the full-scale indication of the panel meter.

Zero the recorder with no input to the voltmeter, but with power on and meter warmed up. The recorder will then give a reading corresponding to the reading on the panel meter. The speed with which voltage changes are recorded is determined by the response time of the recorder alone for voltage changes less the 20% of the full-scale indication of the panel meter. When changes greater than 20% of full-scale occur, the voltmeter itself requires several seconds to reach a correct indication.

Potentiometric Recorder. A potentiometric recorder may be used with the voltmeter if the circuit diagramed below is inserted between the RECORDER terminals on voltmeter and the recorder input.



R2 should be numerically equal in ohms to the full-scale rating of the recorder stated in millivolts. For example, if full scale the recorder is 10 mv, R2 should be 10 ohms. R2 should equal 1400 ohms minus R1. Current through R2 will vary linearly from zero to 1 ma as the panel meter indication varies from zero to a full-scale indication.

Disconnecting a Recorder. Either type of recorder may be disconnected without impairing the operation of the meter by moving the RECORDER toggle switch to the off position. This places a resistor (approximately 1500 ohms) in series with the meter in place of the 1400-ohm resistance across the RECORDER terminals.

CIRCUIT DESCRIPTION

Figure 1 is a simplified schematic diagram of the voltmeter. The following description refers frequently to this drawing.

The two rotary range switches on the front panel connect the INPUT terminals across some fraction of the primary winding of transformer T101. The turns ratio between the primary and secondary windings of this transformer is such that the secondary winding produces the same voltage (about 6.3 volts rms) at all range switch settings provided that the voltage across the INPUT terminals equals the voltage indicated by the range switches. The voltage across the secondary is applied across a thermal bridge consisting of RT101, RT102, R121, R122 and R123. The bridge output potentiometer R121 (the ZERO ADJ) is adjusted during calibration so that the voltage at the wiper arm is zero when the secondary voltage is about 6.3 volts. This circuitry provides a method of, in effect, subtracting the voltage indicated by the range switches from the input voltage. Whenever the INPUT voltage equals the voltage indicated by the range switches the bridge output is zero; consequently, the succeeding circuitry has no input and the indicating meter reads zero.

When the input voltage deviates from the range switch setting, the thermal bridge becomes unbalanced due to the non-linear resistive properties of RT101 and RT102. Then the bridge output deviates from zero an amount proportional to the percentage variation in the INPUT voltage. The deviation is approximately 8 mv per 1% increase or decrease in input voltage. Now the bridge output could be simply amplified and demodulated to drive a meter, but in this case the meter would indicate the percentage deviation from the range switch setting rather than a deviation in terms of volts. On this voltmeter the bridge output is amplified an amount proportional to the setting of the range switches. For example, when the range switches are set at 100, a deviation of one volt from 100 will cause the bridge output to rise to about 8 mv. The 8-mv signal will be amplified by a factor of approximately 1000 to produce an 8-volt signal representing a 1-volt input deviation. However, when the range switches are set at 200, a deviation of one volt causes the bridge output to rise only 4 mv. In this case the 4-mv signal is amplified twice as much as the 8-mv signal to rproduce a 8-volt signal.

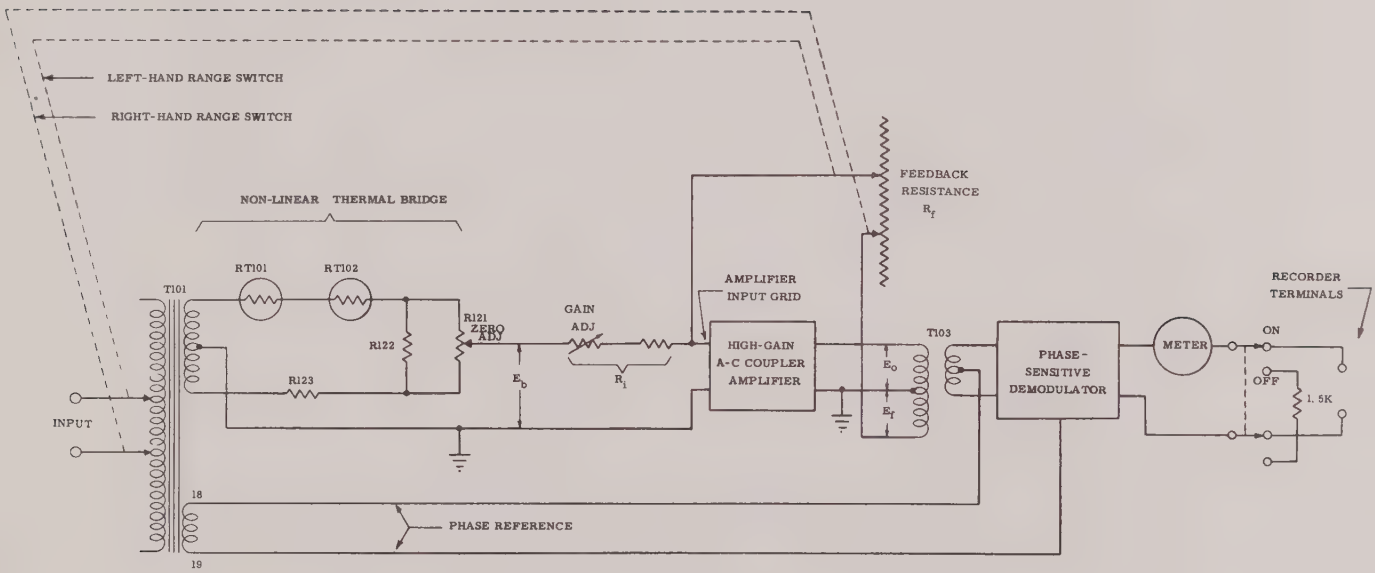


FIGURE 1 SIMPLIFIED SCHEMATIC DIAGRAM

The variable amplification described in the preceding paragraph is accomplished by an extremely high-gain amplifier in combination with variable resistive feedback. The open-loop gain of the amplifier may be considered infinite for practical purposes, so the actual gain depends solely on the amount of feedback. The feedback voltage (e_f) is obtained from a secondary winding on the amplifier output transformer. e_f is a constant fraction (approx..002) of the output voltage (e_o). e_f is applied to the amplifier grid through a variable feedback resistance (R_f). The bridge output (e_b) is coupled to the same grid through an input resistance R_i. Under these conditions:

$$e_o = .002\frac{R_f}{R_i}e_i$$

Since R_i is constant once the GAIN ADJ potentiometer has been set, the gain of the amplifier is directly proportional to R_f. R_f is varied by the range switches so that it is always directly proportional to the voltage indicated by the switches, thus providing high gain at high switch settings and lower gain at lower settings. The amplifier output e_o is always proportional to the deviation in volts of the input voltage from the switch setting.

The thermal bridge also discriminates input voltages above the setting of the range switches from those below. The bridge output when the input is above the switch indications is 180^o out of phase with the output when the input is below the switch indications. This phase difference is preserved at the output of the amplifier.

The phase-sensitive demodulator puts out a d-c current whose amplitude is proportional to the a-c voltage from the amplifier. The direction of this current is determined by the phase difference between the amplifier output and the phase reference signal. The phase reference signal is the voltage at terminal 19 of T101, with respect to terminal 18. When the amplifier output is zero (that is, when the input voltage is that indicated by the range switches) no current flows in the meter and the pointer rests at zero. When the amplifier output is above zero and 180^o out of phase with the reference signal (that is, when the input is less than the voltage indicated by the range switches) the meter is deflected off-scale to the left. When the amplifier output is above zero and in phase with the reference signal (that is, when the input voltage is above that indicated by the range switches) current flows through the meter in the opposite direction, deflecting it to the right.

MAINTENANCE

A. GENERAL

Maintenance for the Model 101 and 101-50 is simple and un-complicated, consisting of occasional calibration and/or tube replacement. Calibration is seldom required. However, recalibration may be necessary if a thermocouple (RT101, RT102) or transformer is replaced.

B. TEST EQUIPMENT REQUIRED

Audio Voltage Standard, Holt Model AVS323, or equivalent.

C. CALIBRATION

1. Meter Adjustment

   Conditions: Instrument energized, no input

   Procedure: Adjust screw on meter face for zero

2. Demodulator Tube Check

   Conditions: Instrument energized, no input

   Procedure: Flip RECORDER switch ON and OFF. If meter reading varies between ON and OFF conditions, replace V103 and V104 with a matched pair of 6AL5's.

3. Zero Adjustment

   Conditions: Instrument energized

   Procedure:
   1) Set Range switches to 100 and 0
   2) Apply 100 volts rms, 400 cps to INPUT
   3) Adjust ZERO ADJ control (R121) for zero reading

NOTE

> If instrument cannot be zeroed with R121, it may be necessary to change the value of R151.

4. Gain Adjustment

Conditions: Instrument energized

Procedure: 1) Set Range switches to 50 and 0

2) Apply 55 volts rms, 400 cps to INPUT

3) Adjust GAIN ADJ control (R120) for a reading of 5

NOTE

> If GAIN ADJ cannot be made, change the value of R127.

4) Recheck zero adjustment.

SPARE PARTS LIST

RECOMMENDED SPARES FOR [illegible] OPERATION

EQUIPMENT [illegible]
CAT. NO. [illegible]
LOT [illegible]

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0001		20	101-401788	THUMB-SCREW, 10-32 THD.	BECKMAN	101-401788	2		.50	
0002		20	325-802712	KNOB, BLACK PLASTIC, 1-1/4 DIA.	KURZ-KASCH	S-648-3BBL	2	0	.50	
0003		20	330-401789	HANDLE, LEATHER STRAP, BLACK	BECKMAN	330-401789	1	0	.50	
0004	R138	20	601-000565	RESISTOR, FIXED, COMP, 22K, 1/2W, 5%	ALLEN BRD	EB2235	4	2	.20	.40
0005	R139			SAME AS ITEM 0004						
0006	R140			" " " "						
0007	R141			" " " "						
0008	R144	20	601-008078	RESISTOR, FIXED, COMP, 1.5K, 1/2W, 10%	ALLEN BRD	EB1521	1	1	.20	.20
0009	R102	20	601-008080	RESISTOR, FIXED, COMP, 2.2K, 1/2W, 10%	ALLEN BRD	EB2221	2	1	.20	.20
0010	R103			SAME AS ITEM 0009						
0011	R154	20	601-008083	RESISTOR, FIXED, COMP, 3.9K, 1/2W, 10%	ALLEN BRD	EB3921	1	1	.20	.20
0012	R137	20	601-008099	RESISTOR, FIXED, COMP, 120K, 1/2W, 10%	ALLEN BRD	EB1241	1	1	.20	.20
0013	R130	20	601-008148	RESISTOR, FIXED, COMP, 1M, 1/2W, 10%	ALLEN BRD	EB1051	1	1	.20	.20
0014	R124	20	601-008852	RESISTOR, FIXED, COMP, 22M, 1/2W, 5%	ALLEN BRD	EB2265	1	1	.20	.20
0015	R118	20	601-010684	RESISTOR, FIXED, COMP, 3.3K, 1/2W, 10%	ALLEN BRD	EB3321	1	1	.20	.20
0016	R125	20	601-013194	RESISTOR, FIXED, COMP, 1.2M, 1/2W, 5%	ALLEN BRD	EB1255	1	1	.20	.20
0017	R152	20	601-015052	RESISTOR, FIXED, COMP, 10K, 1/2W, 5%	ALLEN BRD	EB1035	1	1	.20	.20
0018	R133	20	601-015083	RESISTOR, FIXED, COMP, 220K, 1/2W, 5%	ALLEN BRD	EB2245	1	1	.20	.20
0019	R128	20	601-015086	RESISTOR, FIXED, COMP, 470K, 1/2W, 5%	ALLEN BRD	EB4745	1	1	.20	.20
0020	R135	20	601-015446	RESISTOR, FIXED, COMP, 470 OHM, 1/2W, 5%	ALLEN BRD	EB4715	1	1	.20	.20
0021	R126	20	601-015449	RESISTOR, FIXED, COMP, 1.8K, 1/2W, 5%	ALLEN BRD	EB1825	1	1	.20	.20
0022	R101	20	601-800024	RESISTOR, FIXED, COMP, 33 OHMS, 1/2W, 10%	ALLEN BRD	EB3301	2	1	.20	.20
0023	R104			SAME AS ITEM 0022						
0024	R155	20	601-800031	RESISTOR, FIXED, COMP, 470 OHM, 1/2W, 10%	ALLEN BRD	EB4711	1	1	.20	.20
0025	R131	20	601-800068	RESISTOR, FIXED, COMP, 56K, 1W, 5%	ALLEN BRD	GB5635	2	1	.20	.20

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 Hrs. OPERATION

EQUIPMENT Model 101-50
CAT. NO. 050-400033
LOT 14

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0026	R126			Same as item 0025						
0027	R127	20	604-800815	Resistor, Fixed, WW, 50 Ohms, 1W, 1%	Shallcros	BX193	1	1	1.40	1.40
0028	R128	20	604-800882	Resistor, Fixed, WW, 4.7 Ohms, 1/2W, 5%	Inter Res	BW-1/2	1	1	1.00	1.00
0029	R129	20	604-811325	Resistor, Fixed, WW, 820 Ohms, 1W, .5%	Cal-Ohm	EMS	4	1	2.00	2.00
0030	R130			Same as item 0029						
0031	R131			" " " "						
0032	R108			" " " "						
0033	R109	20	604-811326	Resistor, Fixed, WW, 82 Ohms, 1W, .5%	Cal-Ohm	EMS	9	2	2.25	4.50
0034	R110			Same as item 0033						
0035	R111			" " " "						
0036	R112			" " " "						
0037	R113			" " " "						
0038	R114			" " " "						
0039	R115			" " " "						
0040	R116			" " " "						
0041	R117			" " " "						
0042	R149	20	604-812017	Resistor, Fixed, WW, 200 Ohms, 1W, 5%	Cal-Ohm	EMS	2	1	1.75	1.75
0043	R150			Same as item 0042						
0044	R167	20	607-801021	Resistor, Fixed, Film, 150 Ohms, 1/2W, 1%	Inter Res	DCC-151F	1	1	.50	.50
0045	R119	20	607-801030	Resistor, Fixed, Film, 1K, 1/2W, 1%	Welwyn	N-12	1	1	.50	.50
0046	R146	20	607-801046	Resistor, Fixed, Film, 6.3K, 1/2W, 1%	Inter REs	DCC-632F	4	2	.50	1.00
0047	R147			Same as item 0046						
0048	R148			" " " "						
0049	R145			" " " "						
0050	R1.1	20	611-806248	Resistor, Var, WW, 200 Ohms, 2W, 10%	Clarostat	43-200	1	1	.90	.90

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

EQUIPMENT Model 101-50
CAT. NO. 050-400033
LOT 14

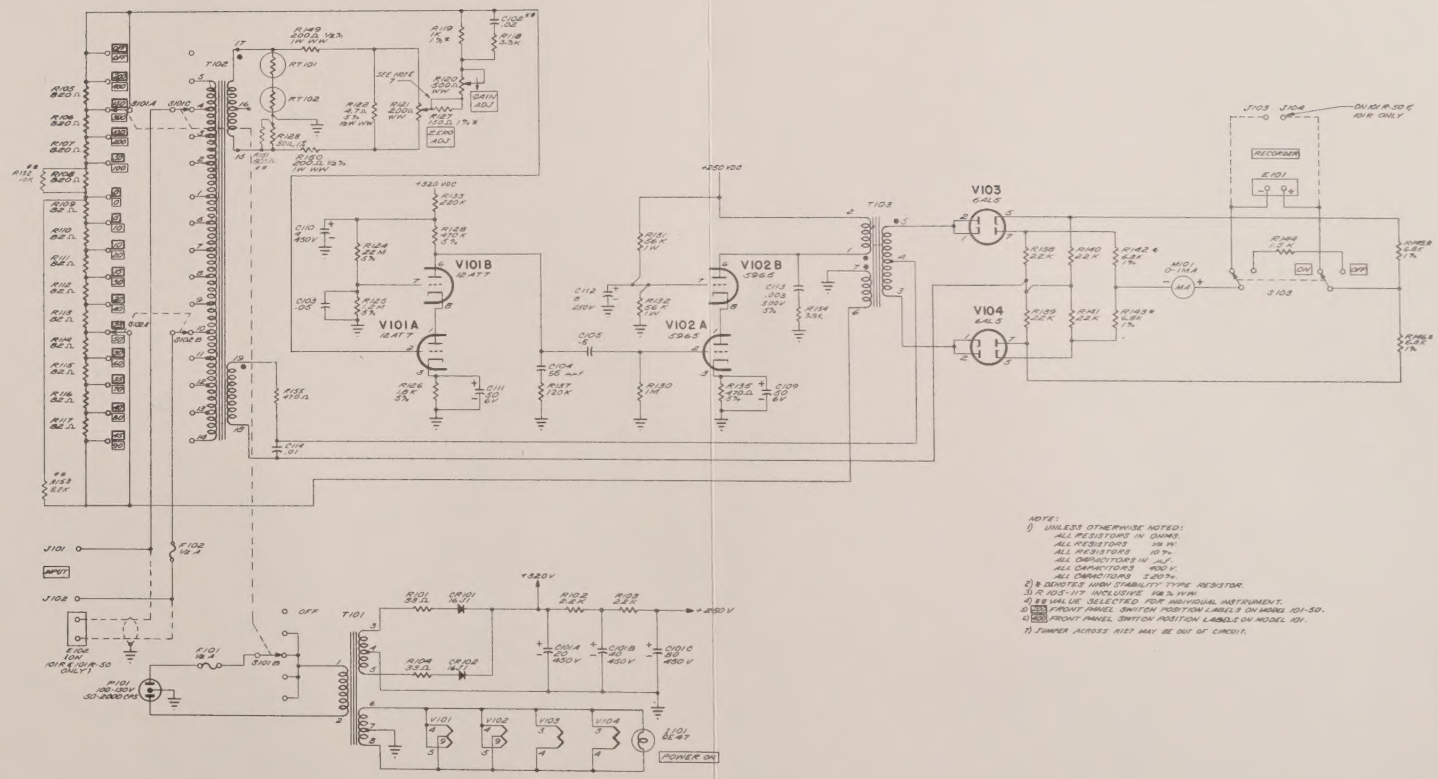
ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0051	R120	20	611-806249	Resistor, Var, WW, 500 Ohms, 2W, 10%	Clarostat	43-500	1	1	2.00	2.00
0052	C109	20	631-802901	Capacitor, Fixed, Elect, 50 MF, 6VDC	Sprague	18D3	2	1	.45	.45
0053	C111			Same as item 0052						
0054	C112	20	631-802946	Capacitor, Fixed, Elect, 8 MFD, 250 VDC	Cornell D	BR825	1	1	.60	.60
0055	C110	20	631-006554	Capacitor, Fixed, Elect, 4 MF, 450 VDC	Sangamo	MT4504	1	1	.65	.65
0056	C101	20	631-802994	Capacitor, Fixed, Elect, Triple, 80-40-20 MF	Sangamo	PLT7419	1	1	2.25	2.25
0057	C104	20	637-804749	Capacitor, Fixed, Mica, 56 MMF, 500V, 5%	Sangamo	RR1456	1	1	.20	.20
0058	C113	20	637-804799	Capacitor, Fixed, Mica, 3000 MMF, 500V, 5%	Sangamo	CR1230	1	1	.50	.50
0059	C114	20	639-804901	Capacitor, Fixed, Paper, .01MF, 400VDC	Sangamo	330411	1	1	.20	.20
0060	C102	20	639-804904	Capacitor, Fixed, Paper, .02MF, 400VDC	Sangamo	330412	1	1	.40	.40
0061	C103	20	639-804909	Capacitor, Fixed, Paper, .05MF, 400V	Sangamo	330415	1	1	.20	.20
0062	C105	20	639-804920	Capacitor, Fixed, Paper, .5 MF, 400V, 5%	Sangamo	330405	1	1	.50	.50
0063		20	664-079205	Cordset, Elect. Power, 3 Cond, Blk, 6 Ft.	Beckman	664-079205	1	0	1.00	
0064	E101	20	691-801353	Terminal Block, Barrier, 2 Terminals	Jones	2-140-Y	1	0	.20	
0065	J101	20	695-807431	Connector, Binding Post, Black	Gen Radio	938C	2	0	.70	
0066	J102			Same as item 0065						
0067	S103	20	701-806040	Switch, Toggle, DPDT, 3 Amp at 250 VAC	Cutler Hm	8373K8	1	0	1.50	
0068	S101	20	711-401784	Switch, Rotary, 2 Sec. 5 Positions	Beckman	711-401784	1	1	1.80	1.80
0069	S102	20	711-401785	Switch, Rotary, 2 Sec. 10 Positions	Beckman	711-401785	1	1	5.50	5.50
0070	F101	20	731-801552	Fuse, Electrical, .5 Amp, 125V, Time Delay	Littelfus	313.500	2	10	.20	2.00
0071	F102			Same as item 0070						
0072	XF101	20	735-007268	Fuseholder, 15 Amp At 250V, Breakdown	Bussman	HKP	2	0	.30	
0073	XF102			Same as item 0072						
0074	V101	20	751-007523	Electron Tube, Duotriode, Type 12AT7	RCA	12AT7	1	2	1.70	3.40
0075	V103	20	751-01[illegible]73[illegible]	Electron Tube, Duodiode, type 6AL5	RCA	6AL5	2	4	1.00	4.00

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 Hrs. OPERATION

EQUIPMENT Model 101-50
CAT. NO. 505-400033
LOT 14

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0076	V104			Same as item 0075						
0077	V102	20	751-800258	Electron Tube, Duotriode, Type 5965	RCA	5965	1	2	2.40	4.80
0078	CR101	20	774-808188	Rectifier, Metallic, Half Wave	Radio Rec	16J1	2	1	1.60	1.60
0079	CR102			Same as item 0078						
0080		20	776-015812	Shield, Tube, 1-3/8 In. High	Cinch Mfg	8660	2	0	.20	
0081		20	776-091703	Shield, Tube, Steel, Cadplated	Cinch Mfg	13B12627P24	2	0	.20	
0082	T101	20	792-401778	Transformer, Power, 460 CT, 6.3 CT, Output	Beckman	792-401778	1	1	22.00	22.00
0083	T103	20	792-401779	Transformer, Interstage, 40V, Input	Beckman	792-401779	1	1	25.00	25.00
0084	T102	20	792-401781	Transformer, Input, 6.3 VCT, 40 V Output	Beckman	792-401781	1	1	67.00	67.00
0085	M101	20	813-401786	Meter, 1 Milliamp Movement	Beckman	813-401786	1	0	30.50	
0086	XI101	20	824-801188	Lampholder, W/Green Lens	Dialight	52410-992	1	0	1.60	
0087	I101	20	825-063063	Lamp, Incandescent, Min. Bayonet Base	Gen Elect	47	1	3	.20	.60
0088	RT101	20	825-802512	Lamp, Incandescent, Min. 2 Pin Base	Gen Elect	12	2	3	.20	.60
0089	RT102			Same as item 0088						
0090	XV101	20	860-002064	Socket, Tube, 9 Pin, W/shield Base	Cinch Mfg	44B12621	2	0	.20	
0091	XV102			Same as item 0090						
0092	XV103	20	860-811796	Socket, Tube, 7 Pin, Saddle Mtg. Min.	Elco	ST235PH	2	0	.20	
0093	XV104			Same as item 0092						
0094		20	864-807063	Insulator, Styrene, 1 Pair, 3/8 OD	Gen Radio	938BB	2	0	.25	



NOTE:
1) UNLESS OTHERWISE NOTED:
ALL RESISTORS IN OHMS.
ALL RESISTORS 1/2 W.
ALL RESISTORS 10%.
ALL CAPACITORS IN μF.
ALL CAPACITORS 400 V.
ALL CAPACITORS ±20%.
2) % DENOTES HIGH STABILITY TYPE RESISTOR.
3) R 105-117 INCLUSIVE 1/2 W WW.
4) ± VALUE SELECTED FOR INDIVIDUAL INSTRUMENT.
5) 101R FRONT PANEL SWITCH POSITION LABELS ON MODEL 101-50.
6) 101 FRONT PANEL SWITCH POSITION LABELS ON MODEL 101.
7) JUMPER ACROSS R187 MAY BE OUT OF CIRCUIT.

SCHEMATIC DIAGRAM
MODEL 101 & 101-50
DWG. NO. 101D101

Nov. 1959

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